

Data Management in Local Public Health: Public Health and GIS

What is GIS?

GIS, which stands for Geographical Information System, is a computer-based tool for mapping and analyzing social and physical information of all kinds. GIS combines database and statistical functions with a visual mapping component that allows the user to manipulate and represent data spatially in multiple layers (**Figure 1**). This technology has made it feasible to use mapping techniques with many public health activities, serving the public more effectively by making information more understandable.

GIS in Public Health

The public health profession, including the Lincoln-Lancaster County Health Department (LLCHD), has found many uses for GIS, ranging from disease mapping to program planning to health education. Examining health data spatially is a very old technique in public health, but one which has been greatly eased by the development of GIS technology. Geographic public health analysis is often traced to the epidemiology pioneer John Snow, who, in 1854, studied the distribution of cholera cases in London neighborhoods. He compared locations of high cholera incidence to the layout of public water systems and found that high incidence occurred in neighborhoods served by particular wells. Snow accurately concluded that a contaminated water supply was the cause of the cholera outbreak.

This kind of applied geographic epidemiology was revolutionized by the innovation of computers and GIS software. GIS has become particularly useful at the local level to study community distribution of disease and

health risks, examine other social and community information, assess needs, plan and implement programs, evaluate service delivery, adjust workloads, develop policies, and communicate public health concepts and health education messages through the graphical ease of computerized mapping (**Figure 2**).

The Lincoln-Lancaster County Health Department has been applying GIS to these public health assessment uses for over 5 years. Starting mainly in environmental health applications, then spreading to other programmatic areas, GIS has been used in Epidemiology, Health Promotion, Dental, Childhood Lead Poisoning Prevention, Women Infant and Children (WIC), Child Care, Public Health Nursing, Pollution Prevention, Water, Solid Waste, Emergency Response, Animal Control programs at LLCHD.

Figure 1

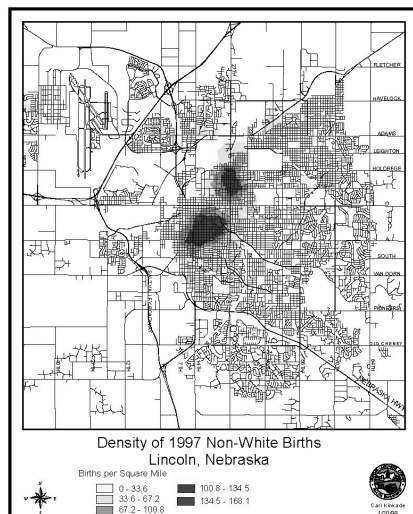
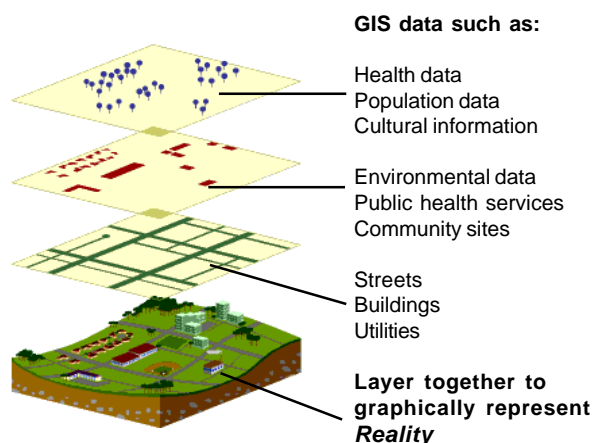


Figure 2

The LLCHD GIS program has also expanded from a technically challenging specialty area to a more widely used technology in which an epidemiologic GIS specialist develops custom applications for other health department staff. Using GIS programming techniques, LLCHD staff have created custom GIS applications that allow staff who are not GIS specialists to use to produce maps routinely needed for the public health services they provide. Applications have been or are being designed for Animal Control, Emergency Response, Public Health Nursing, Land Use Planning Review, and Child Care programs.

GIS Examples at LLCHD

Childhood Lead Poisoning Prevention Program

The Childhood Lead Poisoning Prevention Program has used GIS since 1997 to map lead poisoning cases and target highest-risk neighborhoods for door-to-door screening, follow-up, and prevention efforts. By locating areas of the community that met certain criteria, the LLCHD is able to focus efforts on populations of children with the highest risk of lead poisoning.

These high risk criteria included such factors as density of young children, poverty, and deteriorated housing (**Figure 3**). High risk layers were combined to arrive at a map of target areas used to guide prevention efforts (**Figure 4**).

Emergency Response

Another critical use of GIS is rapid assessment and mapping of risk from hazardous chemicals in the community. In the case of an accidental chemical release, LLCHD can identify the location of the release and quickly determine who would be affected (**Figure 5**). Not only can the vulnerable area be determined, but a sensitive population database, which includes childcare providers, schools, churches, theaters, stadiums, health clinics, and nursing homes, can be overlaid with this area of vulnerability and an evacuation list created in a matter of minutes.

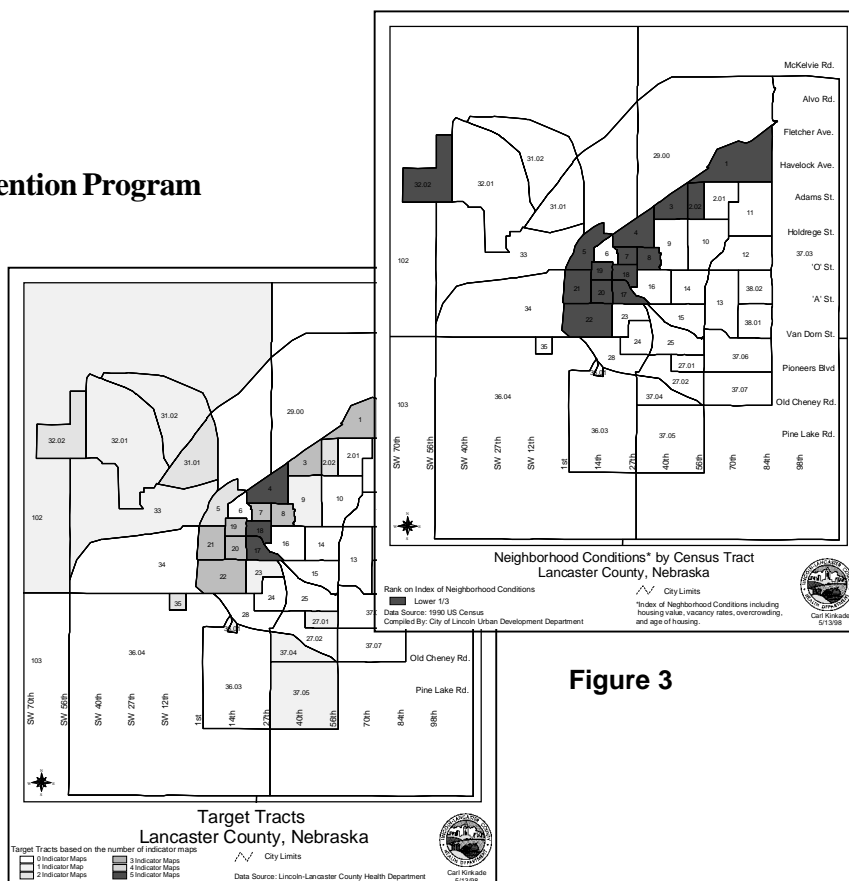


Figure 3

Figure 4

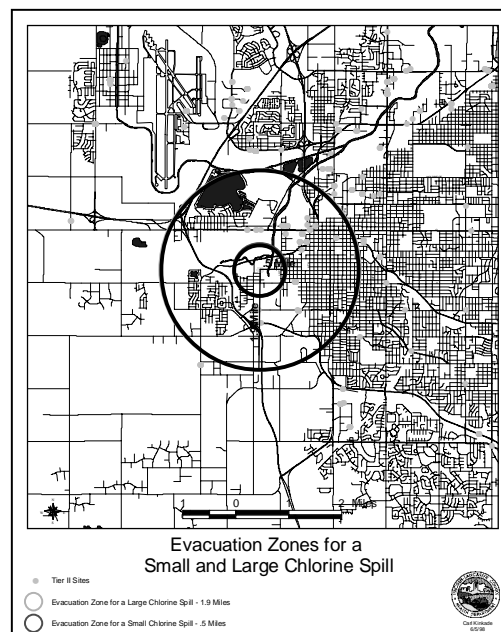


Figure 5

Child Care Program

GIS applications can be customized to assist staff without GIS expertise. At LLCHD, a customized interface has been developed to assist the Child Care Connection. This interface will allow staff to provide specialized information to meet parents' child care search needs.

Currently, if a parent contacts the Child Care Connection for the location of child care providers, they can only be given in a list format for the whole city, by zipcode, or by school district. With the custom application, a parent can request the location of providers by neighborhood, zipcode, school district, for the entire city, or for a certain distance and direction from an address. A list of providers in the area is retrieved and a map showing these locations is produced (**Figure 6**).

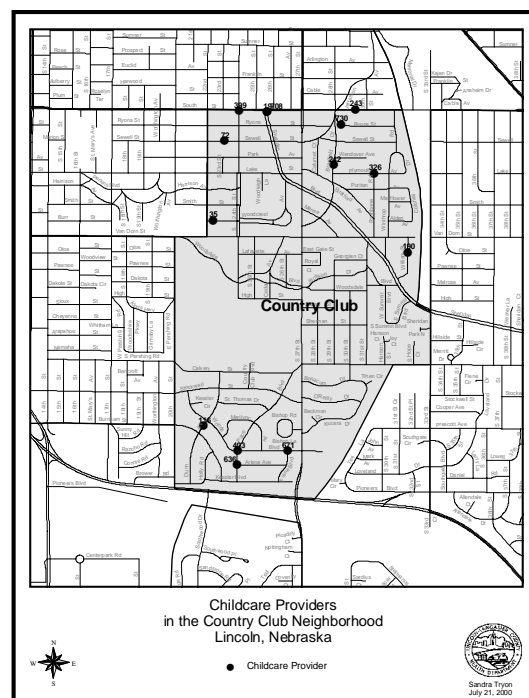


Figure 6

The above are just a few examples the the many potential applications of GIS in local public health. The uses and benefits of GIS for LLCHD have included . . .

Identifying populations with varying health outcomes

- Mapping infant mortality, cancer incidence, or childhood lead poisoning levels

Identifying populations at risk for poor health outcomes

- Mapping toxic releases, well sampling data, or areas of deteriorated older housing
- Overlaying these maps with maps of susceptible populations or resources, social feature, or physical barriers or conduits

Modeling behavior and effect of environmental health threats

- Projecting potential contaminations
- Modeling release flows

Planning and implementing public health interventions

- Identifying strategies to reduce risk
- Targeting populations for prevention and intervention
 - targeting communities for education about environmental health risks
 - targeting businesses for technical assistance on risk reduction

Improving public health communication

- Public health promotion, risk communication, & advocacy
- Educating populations at risk
- Educating those who can mediate risks
- Communication among public health specialists

Program management

- Program Evaluation:
 - Assessing program and community outcomes
 - Evaluating and revising strategies
- Resource Allocation
 - Evaluating the size and distribution of workloads
 - Planning best service/response routes
- Increasing Responsiveness:
 - Improving knowledge and preparedness for environmental health threats
 - Improving short-term evaluation and response to environmental response events

Policy development

- Communicating concepts of health, environmental risk, and policy issues to decision makers
- Providing specific assessment information relative to planning and policy decisions
- Promoting public health considerations in decisions
- Promoting a more informed and involved public

Developing relationships and resources

- Interagency: natural resources, planning, human services
- Private sector: industry, small business, health systems
- Community groups: community action, community centers, ethnic communities, and neighborhoods
- Service fees for assessment/mapping could help support GIS costs

Improvement in assessment

- Efficiency - less computational & mapping time
- Multiple layers of data/mapping available
- New levels of data available- small area and point level
- Increased flexibility through multiple views and contents
- Better accuracy through computerized computations and data management
- Increased responsiveness to information needs

Improvement in data techniques

- Ability to calculate geographic data and analyze relationships among different databases simultaneously
- Ability to visually layer data maps provides ability to see patterns not previously detectable
- Small area and point analysis: more precise and locally valid measurements
- Increased ability to examine relationships between health and other environmental, physical, and social factors
- Translation of other statistical databases and paper databases into GIS databases
- Creation of new databases

Conclusion

GIS has become an advanced, necessary tool for efficient and effective public health assessment. GIS gives public health professionals the ability to quickly examine their data spatially. GIS has become a valued tool used in almost every program at the Lincoln-Lancaster County Health Department and with continued development it will assist the health department in giving the public access to health data that could not have been available in the past.

For more information, contact Carl Kinkade, Assistant Epidemiologist/GIS Coordinator, LLCHD: 402/441-6246.



Leon F. Vinci, MPH, Health Director
Pramod Dwivedi, Interim Public Health Epidemiologist

Return Service Requested

Lincoln-Lancaster County
Health Department
3140 "N" Street
Lincoln, NE 68510-1514